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Bridging Document between the National Standard of the People's Republic of China Classification for Resources/Reserves of Solid Fuels and Mineral Commodities (GB/T 17766-1999) and UNFC

Prepared by the Mineral Resources and Reserves Evaluation Center of the Ministry of Land and Resources of the People's Republic of China in cooperation with the Technical Advisory Group of the Expert Group on Resource Classification[1]

Summary

This document provides the Bridging Document between the National Standard of the People's Republic of China Classification for Resources/Reserves of Solid Fuels and Mineral Commodities (GB/T 17766-1999) and the United Nations Framework Classification for Resources (UNFC). Bridging Documents explain the relationship between UNFC and another classification system that has been endorsed by the Expert Group on Resource Classification as an Aligned System. They incorporate instructions and

[1] This Bridging Document was developed by the Mineral Resources and Reserves Evaluation Center of the Ministry of Land and Resources of the People's Republic of China in cooperation with the Technical Advisory Group of the Expert Group on Resource Classification. Following review by the Expert Group at its eighth session, 24-28 April 2017, the Bridging Document was issued for public comment from 15 February to 15 April 2018. Development of this Bridging Document has followed the Document Approval Procedure agreed by the Expert Group at its fifth session, April 2014. The Bridging Document is presented to the Committee on Sustainable Energy at its twenty-seventh session for endorsement.

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guidelines on how to classify estimates generated by application of that Aligned System using the UNFC Numerical Codes. This Bridging Document compares reserves and resources by Categories and Classes of GB/T 17766-1999 to Categories and Classes of UNFC. GB/T 17766-1999, a national standard issued in 1999, applies to mineral exploration planning and deployment, mineral resources and reserves estimation, preparation of reports of mineral resources and reserves for each stage of exploration and development of mineral resources and reserves. This Bridging Document does not affect the independent application of GB/T 17766-1999 and application of GB/T 17766-1999 does not affect any component of UNFC. In the event of any difference between the Chinese language version and any other language version, the Chinese language version shall prevail.

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I. Introduction

1. This bridging document between the Classification for Resources/Reserves of Solid Fuels and Mineral Commodities (GB/T 17766-1999) (hereinafter referred to as GB/T 17766-1999) and the United Nations Framework Classification for Resources (hereinafter referred to as UNFC) details the correlation between GB/T 17766-1999 and UNFC.

2. GB/T 17766-1999 is independent of UNFC. This bridging document does not affect the independent application of GB/T 17766-1999.

3. The application of GB/T 17766-1999 does not affect any component of UNFC.

II. Overview of GB/T 17766-1999

A. Brief Introduction to GB/T 17766-1999

4. GB/T 17766-1999, a national standard issued in 1999, applies to mineral exploration planning and deployment, mineral resources and reserves estimation, preparation of reports of mineral resources and reserves for each stage of exploration and development of mineral resources and reserves. It is applicable to the evaluation of mineral resources and reserves, registration, statistics, scheduling, planning, formulation of policies on mineral resources and reserves, and the development of mineral exploration rules, standards and guidelines, and can also serve as the basis for mineral rights transfers and financing for mineral exploration and development.

5. GB/T 17766-1999 classifies Identified Mineral Resources and Undiscovered Resources. Identified Mineral Resources are divided into three classes: Mineral Resources, Basic Reserves and Reserves. GB/T 17766-1999 applies a three-dimensional numerical coding scheme in which quantities are classified based on the three fundamental criteria: Degree of Economic Viability (E), Level of Feasibility Assessment (F) and Degree of Geological Assurance (G). Combinations of these criteria form a three-dimensional system. Figure 1 shows the entire classification and codification of GB/T 17766-1999.

Figure I
Classification of GB/T 17766-1999

<table>
<tr><td rowspan="2">Degree of Geological Assurance
Classification Category
Degree of Economic Viability</td><td colspan="3">Identified Mineral Resources</td><td>Undiscovered Resources</td></tr>
<tr><td>Measured</td><td>Indicated</td><td>Inferred</td><td>Reconnaissance</td></tr>
<tr><td rowspan="4">Economic</td><td>Proved Reserves (111)</td><td rowspan="4" colspan="2"></td><td rowspan="8"></td></tr>
<tr><td>Basic Reserves (111b)</td></tr>
<tr><td>Probable Reserves (121)</td><td>Probable Reserves (122)</td></tr>
<tr><td>Basic Reserves (121b)</td><td>Basic Reserves (122b)</td></tr>
<tr><td rowspan="2">Marginal Economic</td><td>Basic Reserves (2M11)</td><td rowspan="2" colspan="2"></td></tr>
<tr><td>Basic Reserves (2M21)</td><td>Basic Reserves (2M22)</td></tr>
<tr><td rowspan="2">Sub-Marginal Economic</td><td>Mineral Resources (2S11)</td><td rowspan="2" colspan="2"></td></tr>
<tr><td>Mineral Resources (2S21)</td><td>Mineral Resources (2S22)</td></tr>
<tr><td>Intrinsic Economic</td><td>Mineral Resources (331)</td><td>Mineral Resources (332)</td><td>Mineral Resources (333)</td><td>(334)?</td></tr>
<tr><td colspan="5">Notes: Codes used in Figure (111– 334)
The first digit refers to economic viability: 1 = Economic; 2M = Marginal Economic; 2S = Sub-Marginal Economic; 3 = Intrinsic Economic? = Economic-Interest Undefined.
The second digit refers to level of Feasibility Assessment: 1 = Feasibility Study; 2 = Prefeasibility Study; 3 = Scoping Study.
The third digit refers to Degrees of Geological Assurance: 1 = Measured; 2 = Indicated; 3 = Inferred; 4 = Reconnaissance; B = Reserves without deducting any design or mining losses.</td></tr>
</table>

B. Characteristics of GB/T 17766-1999

6. As a Chinese national standard, GB/T 17766-1999 together with all related technique specifications and guidelines for exploration, constitutes a complete standard system for mineral resources in China. It can ensure the orderly, high-quality exploration of mineral resources in China.

7. In the field of estimation and management of mineral resources and reserves, China has noteworthy characteristics.

8. The process of mineral exploration and development is divided into three phases: mineral exploration, mine design and construction, and mine production. Mineral exploration is divided into four stages: reconnaissance, prospecting, general exploration, and detailed exploration.

9. Application of industrial indexes is one of the noteworthy characteristics of GB/T 17766-1999. The industrial indexes proposed for the mineral quality and mining technical conditions under technical and economic conditions during a certain period shall serve as the basis for delineation of an ore body and the estimation of mineral resources and reserves. They generally comprise general industrial indexes and verified industrial indexes of a specific ore deposit. The general industrial indexes are derived from the experience accumulated by the industry in the long-term mineral exploration, technical and economic verification and mining activities. They are generally used in reconnaissance and prospecting stages. The verified industrial indexes of a specific ore deposit come from the technical and economic verification through normative procedures and upon comprehensive consideration of geological, mining, metallurgy, comprehensive utilization, economy, environmental protection, laws and regulations, society and government and other factors by technical personnel of different professions. They are generally used for the general exploration, detailed exploration stages, mine design and construction, and mine production phases. The verification of industrial indexes is essentially a process of prefeasibility study or feasibility study.

10. The content of mineral exploration in China not only includes achieving knowledge of regional geology and ore body geology through geochemical and geophysical surveys and prospecting, mapping, trenching, drilling, down-hole geophysics etc., but also comprises doing appraisal and research of hydrogeology, engineering, and environmental geology related to mining technical conditions, and doing research of mineralogy, mineral processing and finally smelting to meet mine design and mine production.

11. GB/T 17766-1999 categories correspond directly to mineral exploration and development stages and level of feasibility assessment as shown in Figure 2.

Figure 2
Correspondence between Phases of Mineral Exploration and Development, Level of Feasibility Assessment and Categories

Phases of Mineral Exploration and Development		*Target*	*Feasibility Assessment*	*Application of Industrial Indexes*	*Categories*
Mineral Exploration Phase	Reconnaissance Stage	Find an area with greater potential for mineralization	Quite simple technical and economic assessment	General industrial index	(334)?
	Prospecting Stage	Find a deposit	Scoping study	General industrial indexes	(333), (334)?
	General Exploration Stage	Make a judgment whether the project has any commercial value or not	Prefeasibility study or scoping study	Verified industrial indexes	If a deposit has a potentially commercial value, based on a scoping study, the categories are mainly (332), (333), with a few (334)?; based on a prefeasibility study, the categories are (122b), (333). If it has no commercial value, the exploration project will be finalized, with no resources registered into the national resources or reserves base
	Detailed Exploration Stage	Conduct detailed exploration to provide grounds for a feasibility study or mine design and development	Feasibility study, prefeasibility study or scoping study	Verified industrial indexes	Scoping study: (331), (332) and (333). Prefeasibility study: (121b), (122b), (333), (121), (122). Feasibility study: (111b), (122b), (333), (111), (122)
Mine Design and Construction Phase		Complete mine development and construction on schedule	Mine design	Verified industrial indexes	(111b), (122b), (333), (111), (122)
Mine Production Phase		Achieve commercial production on schedule and meet cash flow requirement and quality specification	Production plan	Verified industrial indexes	(111b), (122b), (333), (111), (122)

III. Overview of UNFC

12. UNFC was developed by experts under the auspices of the United Nations Economic Commission for Europe (UNECE) and was published by UNECE. UNFC applies to international energy and mineral research, government resource management as well as the industrial process planning and efficient capital allocation of businesses.

13. UNFC is a generic principle-based system in which quantities are classified based on the three fundamental criteria: economic and social viability (E), field project status and feasibility (F), and geological knowledge (G), using a three-dimensional numerical independent coding scheme. Combinations of these criteria form a three-dimensional system.

14. Each criterion (axis) is divided into various categories. For example, the F axis is divided into three categories: F1, F2 and F3, and each category is further divided into a number of sub-categories (for example, F1 is further divided into F1.1, F1.2 and F1.3). The specific classification is shown in Figure 3.

Figure 3
UNFC Classes and Sub-classes Defined by Categories and Sub-categories

UNFC Classes Defined by Categories and Sub-categories						
Total Commodity Initially in Place	Extracted	Sales Production				
		Non-sales Production				
	Class		Sub-class	Categories		
				E	F	G
	Known Deposit	Commercial Projects	On Production	1	1.1	1.2.3
			Approved for Development	1	1.2	1.2.3
			Justified for Development	1	1.3	1.2.3
		Potentially Commercial Projects	Development Pending	2	2.1	1.2.3
			Development On Hold	2	2.2	1.2.3
		Non-Commercial Projects	Development Unclarified	3.2	2.2	1.2.3
			Development Not Viable	3.3	2.3	1.2.3
		Additional Quantities in Place		3.3	4	1.2.3
	Potential Deposit	Exploration Projects	No sub-classes defined	3.2	3	4
		Additional Quantities in Place		3.3	4	4

IV. Alignment of Axes

A. Alignment of the G Axis

15. In GB/T 17766-1999, the G axis represents the degrees of geological assurance, representing the confidence in exploration results, and is divided into four categories: (i) Measured; (ii) Indicated; (iii) Inferred; and (iv) Reconnaissance.

16. In UNFC, the G axis represents geological knowledge and is divided into four categories.

17. The categories of the G axis of GB/T 17766-1999 and UNFC essentially correspond to each other one on one as shown in the grey area (Degree of geological assurance rows) in Figure 4.

Figure 4
Alignment of the Axes of GB/T 17766-1999 and UNFC

<table>
<tr><th colspan="2" rowspan="2">GB/T 17766-1999</th><th colspan="3">UNFC</th></tr>
<tr><th>Category</th><th>Sub-Category</th><th></th></tr>
<tr><td rowspan="7">Degree of Economic Viability</td><td>1</td><td>E1</td><td>E1.1
E1.2</td><td rowspan="7">Economic and Social Viability</td></tr>
<tr><td>2M</td><td rowspan="3">E2</td><td rowspan="3"></td></tr>
<tr><td>2S</td></tr>
<tr><td>3</td></tr>
<tr><td></td><td rowspan="3">E3</td><td>E3.1</td></tr>
<tr><td>3</td><td>E3.2</td></tr>
<tr><td></td><td>E3.3</td></tr>
<tr><td rowspan="5">Level of Feasibility Assessment</td><td>1</td><td rowspan="2">F1/F2</td><td></td><td rowspan="5">Field Project Status and Feasibility</td></tr>
<tr><td>2</td><td></td></tr>
<tr><td rowspan="2">3</td><td>F2</td><td></td></tr>
<tr><td>F3</td><td></td></tr>
<tr><td></td><td>F4</td><td></td></tr>
<tr><td rowspan="4">Degree of Geological Assurance</td><td>1</td><td>G1</td><td></td><td rowspan="4">Geological Knowledge</td></tr>
<tr><td>2</td><td>G2</td><td></td></tr>
<tr><td>3</td><td>G3</td><td></td></tr>
<tr><td>4</td><td>G4</td><td></td></tr>
</table>

B Alignment of the F Axis

18. In GB/T 17766-1999, the F axis represents the level of feasibility assessment and is divided into three categories: (i) Feasibility study, (ii) Prefeasibility study, and (iii) Scoping study. No sub-category is defined.

19. In UNFC, the F axis represents the field project status and feasibility and is divided into four categories: F1, F2, F3 and F4, in which F1 and F2 can be divided into sub-categories. The alignment of the F axis is shown in the blue area (Level of feasibility assessment rows) in Figure 4.

20. GB/T 17766-1999 emphasizes the level of the feasibility assessment, and UNFC emphasizes field project status and technical feasibility. Their categories do not directly correspond to each other. Generally, a feasibility study or prefeasibility study on the technical factors may have two results: one is that the current technical condition can meet the requirement of a mine development or production; the other is that the technical

feasibility of the project needs to be confirmed further. Therefore, both categories "1" and "2" of the F axis in GB/T 17766-1999 may correspond to F1 or F2 in UNFC.

21. A scoping study in GB/T 17766-1999, which is a preliminary assessment of the technical and economic viability for the development of mineral resources, may apply to all stages of mineral exploration activities. The conclusions of the scoping study in the prospecting stage have a relatively low degree of confidence. The conclusions of the scoping study based on general exploration and detailed exploration have a higher degree of confidence, especially with verification of industrial index. The scoping study corresponds to F2 or F3 in UNFC.

22. At the reconnaissance stage in GB/T 17766-1999, it is required that local geological studies and exploration activities, site-specific geological studies and exploration activities should be done and Undiscovered Resources may be estimated. The category of the level of the feasibility assessment at this stage in GB/T 17766-1999 is 3. In this case, the level of the technical feasibility in GB/T 17766-1999 corresponds to F3 in UNFC as shown in Figure 4.

23. F4 in UNFC is not defined in GB/T 17766-1999.

C. Alignment of the E Axis

24. In GB/T 17766-1999, the E axis represents the evaluation of the economic rationality at the time, and is divided into 4 categories: Economic, Marginal Economic (2M), Sub-Marginal Economic (2S) and Intrinsic Economic. No sub-categories are defined.

25. In UNFC, the E axis represents economic and social viability, and is divided into E1, E2 and E3 categories. E1 and E3 can be divided into sub-categories.

26. In GB/T 17766-1999, "Economic" represents the fact that the prefeasibility or feasibility study shows that extraction at the time is economically reasonable under the market conditions, or it is possible to develop with assistance from government subsidies and other forms of assistance. It corresponds to E1.1, E1.2 sub-categories in UNFC;

27. "Marginal Economic" represents the fact that the prefeasibility or feasibility study shows that extraction at the time is uneconomic, but may become economic as a result of improved conditions or through other supportive measures of governments in the future. It corresponds to E2 in UNFC.

28. "Sub-Marginal Economic" represents the fact that the prefeasibility or feasibility study shows that extraction at the time is not economic or is not technically feasible and would require substantially higher commodity prices or a major cost-reducing advance in technology before it becomes economic. Generally, it corresponds to E2 in UNFC.

29. "Intrinsic Economic" refers to the mineral resources which have been through a scoping study. It represents the fact that extraction of the mineral resources is expected to become economically viable in the foreseeable future. Category "Intrinsic Economic" corresponds to E2 in UNFC.

30. "Economic-Interest Undefined", where it is impossible to determine its degree of economic viability due to insufficient information, only corresponds to undiscovered resources achieved at the reconnaissance stage in GB/T 17766-1999. It corresponds to E3.2 in UNFC.

31. E3.1 and E3.3 in UNFC are not defined in GB/T 17766-1999.

V. Alignment of Classes and Categories

32. GB/T 17766-1999 and UNFC do not correspond to each other very well at the level of the E and F axes, but they may correspond between classes as shown in Figure 5 and Figure 6.

33. "Reserves" in GB/T 17766-1999 correspond to the "Commercial Projects" class in UNFC.

34. "Basic Reserves" with "b" in GB/T 17766-1999 generally correspond to "Reserves" plus relevant design or mining losses. For example, (111b) equals to (111) plus (design or mining losses). They are not defined in UNFC.

35. "Basic Reserves" beginning with "2M" corresponds to the "Potentially Commercial Projects" class in UNFC.

36. "Mineral Resources" beginning with 2S in GB/T 17766-1999 correspond to the "Potentially Commercial Projects" class in UNFC.

37. "Intrinsic Economic Mineral Resources" correspond to "Potentially Commercial Projects" class in UNFC.

38. "Economic-Interest Undefined Undiscovered Resources", that is (334)?, correspond to the "Exploration Projects" class in UNFC.

Figure 5
Mapping of GB/T 17766-1999 to UNFC Classes and Categories

<table>
<tr><th colspan="2">GB/T 17766-1999 Classes</th><th colspan="4">GB/T 17766-1999 Categories</th><th>UNFC Classes</th><th colspan="3">UNFC "minimum" Categories</th></tr>
<tr><td rowspan="2">Economic</td><td rowspan="2">Reserves</td><td>(111)</td><td></td><td></td><td></td><td rowspan="2">Commercial Projects</td><td rowspan="2">E1</td><td rowspan="2">F1</td><td rowspan="2">G1,G2</td></tr>
<tr><td>(121)</td><td>(122)</td><td></td><td></td></tr>
<tr><td rowspan="2"></td><td rowspan="4">Basic Reserves</td><td>(111b)</td><td></td><td></td><td></td><td colspan="4" rowspan="2">Not defined in UNFC</td></tr>
<tr><td>(121b)</td><td>(122b)</td><td></td><td></td></tr>
<tr><td>Marginal Economic</td><td>(2M11)</td><td></td><td></td><td></td><td rowspan="4">Potentially Commercial Projects</td><td rowspan="4">E2</td><td rowspan="4">F2</td><td rowspan="4">G1,G2,G3</td></tr>
<tr><td></td><td>(2M21)</td><td>(2M22)</td><td></td><td></td></tr>
<tr><td>Sub-Marginal Economic</td><td rowspan="3">Mineral Resources</td><td>(2S11)</td><td></td><td></td><td></td></tr>
<tr><td></td><td>(2S21)</td><td>(2S22)</td><td></td><td></td></tr>
<tr><td>Intrinsic Economic</td><td>(331)</td><td>(332)</td><td>(333)</td><td></td></tr>
<tr><td>Economic-Interest Undefined</td><td>Undiscovered Resources</td><td></td><td></td><td></td><td>(334)?</td><td>Exploration Projects</td><td>E3</td><td>F3</td><td>G4</td></tr>
</table>

Figure 6
Mapping of GB/T 17766-1999 to UNFC by E and F Axes

	F1.1	F1.2	F1.3	F2.1	F2.2	F2.3	F3	F4
E1.1			3	4				
E1.2			3					
E2			4	4				
E3.1	10	10	10	10	10	10		
E3.2			6	6	6			
E3.3								8

			UNFC Sub-Classes
Economic	Reserves		On production
			Approved for Development
		3	Justified for Development
	Basic Reserves	Not defined in UNFC	
Marginal Economic	Basic Reserves	4	Development Pending
			Development On hold
Sub-marginal Economic	Mineral Resources	4	Development Pending
			Development On hold
Intrinsic Economic	Mineral Resources	4	Development Pending
			Development On hold
Not defined in GB/T 17766-1999		6	Development Unclarified
			Development Not Viable
		8	Additional Quantities in Place
Economic-Interest Undefined	Undiscovered Resources	9	Exploration Project
Not defined in GB/T 17766-1999		10	Quantities forecast to be extracted but not for sale
Less Common Mappings			